ACCESSION #: 9605280262

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Browns Ferry Nuclear Plant

(BFN) Unit 3 PAGE: 1 OF 8

DOCKET NUMBER: 05000296

TITLE: Unit 3 Scram Following Loss Of Reactor Feedpump 3C.

EVENT DATE: 4/21/96 LER #: 96-002-00 REPORT DATE: 05/21/96

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:

NAME: B. C. Morris, Licensing Engineer TELEPHONE: (205) 729-7909

COMPONENT FAILURE DESCRIPTION:

CAUSE: B SYSTEM: SJ COMPONENT: FCV MANUFACTURER: A365

B CE HX P160

REPORTABLE NPRDS: Y

N

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On April 21, 1996, at 0351 hours, a low reactor water level scram occurred on Unit 3. The event was initiated by the loss of reactor feedwater pump (RFP) 3C while aligning RFP 3C's oil tank to the oil purification system. The discharge check valve on RFP 3C was damaged during the pump trip transient and was not full seated. This allowed back flow from he discharge of the two operable RFPs through RFP line 3C. Thus, RFPs 3A

and 3B were unable to maintain vessel water level and the unit scrammed. The High Pressure Coolant Injection (HPCI) system and the Reactor Core Isolation Cooling system auto-started on low reactor water level and restored vessel level. All automatic Engineered Safeguard Features and all automatic isolations or actuations of primary and secondary containment group logic systems functioned as expected.

The RFP trip was caused by personnel error. An Assistant Unit Operator improperly aligned oil valves resulting in draining the RFP 3C oil tank. Appropriate personnel corrective action was taken. A human performance evaluation is also being performed to determine if additional actions are needed. Due to the nature of the pump trip, RFP 3C experienced a faster than normal closure of the discharge check valve which damaged the valve. Inspection of the valve also showed operational wear was present. Engineering is performing a failure evaluation on the valve wear to determine what modifications are needed to improve the performance of the valves.

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I. PLANT CONDITIONS

Prior to this event Unit 3 was operating at 100 percent power. Unit 1 was shutdown and defueled. Unit 2 was shutdown for a scheduled refueling outage.

II. DESCRIPTION OF EVENT

A. Event:

On April 21, 1996, at 0351 hours, a low reactor water level scram occurred on Unit 3.

At approximately 0345 hours, activities were in progress in the turbine building to align the reactor feedpump [SJ] 3C oil tank to the turbine oil purifier system [TD]. This was a scheduled activity assigned to an Assistant Unit Operator (AUO) [utility, nonlicensed]. A low reactor feedwater pump 3C oil tank level alarm [ALM] was received in the main control room followed by alarms indicating low oil header pressure on reactor feedpump 3C. The speed of reactor feedpump 3C decreased and reactor feedpumps 3A and 3B increased discharge flow due to the loss of flow from the reactor feedpump 3C. Reactor recirculation pumps 3A and 3B [AD] automatically ran back to reduce power. Reactor feedpumps 3A and 3B were unable to maintain water level and the reactor scrammed. Water level continued to decrease and the High Pressure Coolant Injection system (HPCI) (BJ] and the Reactor Core Isolation Cooling system (RCIC) [BN] auto-started and assisted reactor feedpumps 3A and 3B in restoring vessel level. Reactor water level continued to increase and HPCI and RCIC, and reactor feedpumps 3A and 3B tripped on high reactor water level as would be expected. An Assistant Shift Operations Supervisor (ASOS) [utility, licensed] had been dispatched to investigate the oil alarms and reported that the reactor feedpump 3C discharge check valve had a steam/water leak and requested the Unit Operator (UO) [utility, licensed) to isolate reactor feedpump 3C. The UO then closed the motor operated discharge valve on reactor feedpump 3C.

The high reactor water level trips on reactor feedpumps 3A and 3B were reset after water level decreased and reactor water level control was maintained using reactor feedpumps.

At 0407 hours, HPCI auto-started following an improper reset of the trip logic. HPCI was immediately secured by the operator.

The post-trip evaluation concluded the AUO had made a valve alignment error that resulted in oil being inadvertently gravity drained to the main turbine oil tank from the reactor feedpump 3C oil tank. The oil loss caused a loss of reactor feedpump 3C hydraulic pressure resulting in closure of the turbine stop and

control valves, and caused the speed of reactor feedpump 3C pump to decrease. The loss of oil also resulted in damage to journal bearings on the reactor feedpump 3C turbine.

Browns Ferry's feedwater system is designed such that the loss of a single reactor feedpump can be compensated for by increased output of the other two reactor feedpumps in combination with an automatic run back of the reactor recirculation system pumps. The transient data showed part of the reactor feedpump discharge flow from the two operable reactor feedpumps was in reverse flow through reactor water feedpump line 3C. With this back flow, reactor feedpumps 3A and 3B were unable to provide sufficient feedwater flow to the reactor to maintain vessel level.

Reactor feedpump 3C discharge check valve was disassembled and inspected. The inspection revealed that the disk pin was sheared detaching the disc from the swing arm. In this configuration, the discharge check valve was not fully seated and a reverse flow path existed through the reactor feedpump 3C pump line and the associated minimum flow line. The antirotation pin was not intact and the disk nut was backed off the disc pin two to three threads. There was also evidence of disc rotation.

The sequence of events likely contributed to the damaged check valve. Closure of this valve is normally assisted by a spring loaded actuator that is released in conjunction with reactor feedpump trip signals. For this transient a normal trip signal was not generated and the rapid flow reversal may have caused a faster than normal closure resulting in damage to the check valve, the observed steam leak on the check valve packing, and a broken air line found on the actuator for the discharge check valve.

All automatic Engineered Safety Features (ESF) [JE] actuations and the primary and secondary containment system isolations and actuations occurred as expected. Restoration of the Reactor Water Cleanup (RWCU) [CE] system to service was delayed due to a leak from a head flange on the regenerative heat exchanger.

The event is reportable pursuant to 10 CFR 50.73(a)(2)(iv) as any event that resulted in automatic actuation of an ESF. The second HPCI start is not considered a reportable event since

the start signal was not valid and HPCI had completed its

safety function.

B. Inoperable Structures, Components, or Systems that Contributed

to the Event:

None.

C. Dates and Approximate Times of Major Occurrences:

April 21, 1996,

at 0145 hours CST - An Assistant Unit Operator (AUO) isolated

the Unit 3 main turbine oil tank from the

turbine lube oil purification system.

at 0345 hours CST - The AUO opened the reactor feedpump 3C oil

tank valves.

at 0348 hours CST - RFP 3C Oil Tank Level Abnormal annunciation

was received in the control room.

at 0351 hours CST - RFP 3C Trip alarm was received on the alarm

recorder.

at 0351 hours CST - Reactor water level decreased resulting in

a reactor scram.

at 0351 hours CST - Reactor water level continued to decrease

resulting in a HPCI and RCIC system

initiation.

at 0353 hours CST - Reactor feedpumps 3A and 3B and HPCI/RCIC

tripped on high vessel water level.

at 0354 hours CST - ASOS reported steam/water leak on the

reactor feedpump 3C discharge check valve.

UO closed the reactor feedwater pump 3C

motor operated discharge valve.

at 0358 hours CST - Scram was reset.

at 0402 hours CST - Reactor feedpumps 3A and 3B high reactor

water level trips were reset.

at 0407 hours CST - HPCI auto-started and was immediately

secured.

at 0450 hours CST - TVA made a 1-hour notification to NRC in

accordance with 10 CFR 50.72 (b)(1)(iv) for

HPCI injection.

D. Other Systems or Secondary Functions Affected:

The following additional equipment problems were observed:

Three low pressure feedwater heater strings and two high

pressure strings isolated following the trip of the main

turbine.

Engineering is currently evaluating corrective actions.

Two high pressure heater discharge valves stalled while

attempting to return the feedwater heaters to service. A problem report was written to evaluate this further.

The HPCI steam line drain pots took longer to drain than anticipated. A work order was written and no problems were found. Also, Engineering walked down the HPCI steam lines and no problems were found.

Following the event, a steam leak was identified coming from the head flange on RWCU regenerative heat exchanger 3A. This delayed the return of the RWCU system to service. See Section V.B for additional details.

E. Method of Discovery:

Reactor feedpump 3C low oil level and pressure alarms were received in the main control room followed by the reactor scram and ESF actuations.

F. Operator Actions:

Operations personnel [utility, licensed and nonlicensed] responded to the reactor scram according to applicable reactor scram procedures. An ASOS was dispatched to the turbine building to assess the physical status of the reactor feedpump 3C oil system. Operators closed the motor operated discharge valve on the problem reactor feedpump within approximately four minutes of the scram. This action isolated the backflow path through feedpump 3C pump line. The reactor was stabilized in a hot shutdown condition with reactor process parameters at normal values using reactor feedpumps for vessel level control per routine shutdown procedures.

G. Safety System Responses:

All safety systems responded as designed for this type of event.

III. CAUSE OF THE EVENT

A. Immediate Cause:

The immediate cause for the scram was the low reactor water level following the loss of reactor feedpump 3C.

B. Root Cause:

The event was initiated by a personnel error. An AUO improperly aligned oil valves which resulted in draining the oil from reactor feedpump 3C to the main turbine oil tank causing a pump trip.

The feedwater system can tolerate the loss of a single feedpump without scramming the plant. In this case, the discharge check valve on pump 3C sustained damage when it closed and was unable to properly seat. This resulted in the scram since the two active feedpumps were unable to provide sufficient feedwater flow to maintain vessel level. A faster than normal closure of the check valve caused the damage to the valve.

IV. ANALYSIS OF THE EVENT

Plant safety systems and associated components performed as designed. The event is categorized as a partial loss of feedwater event. Full loss of feedwater is an analyzed plant transient and bounds the circumstances associated with this event. Therefore, the event did not affect the health and safety of plant personnel or the public.

V. CORRECTIVE ACTIONS

A. Immediate Corrective Actions:

Operations personnel promptly stabilized the reactor. Reactor feedpump 3C was isolated and reactor feedpump 3C oil tank was refilled.

B. Corrective Actions to Prevent Recurrence:

Appropriate personnel corrective action was taken with the AUO responsible for the valve misalignment. A human performance evaluation is being performed to evaluate the oil alignment problem to determine any additional follow-up corrective actions.

The damaged valve internals on the reactor feedpump 3C discharge check valve were replaced and the damaged turbine journal bearings were repaired. The steam leak and broken air line on reactor feedpump 3C discharge valve were also repaired. The discharge check valves for reactor feedpumps 3A, 3B, 2A, 2B, and 2C were inspected. The valves showed varying degrees of operational wear requiring correction. Wear problems included damaged or missing nut locking pins, damaged disc post threads, and worn antirotation pins. On two valves there was evidence of valve disc rotation and excessive wear in the disk pin to lever

arm interface.

Maintenance and modification records show these valves have a history of wear problems and damaged stems. Past modifications included going to an integral stem design and addition of antirotation pins to prevent disc rotation. The recent inspections demonstrate these modifications have not been successful in limiting valve wear. The valve vendor indicates that design improvements were issued in 1988 recommending a different material for the antirotation pin and seal welding the nut. There is not a specific process in place for utilities to be notified of product improvements on non-safety components and TVA was unaware of these recommendations. The vendor was also consulted on whether mounting the check valve in a vertical piping run, as is the case at Browns Ferry, would cause problems. The vendor stated that, while a horizontal installation was recommended, other plants used the valve in vertical runs with no apparent adverse effects.

TVA Site Engineering is performing an evaluation of the discharge check valves to determine what modifications must be implemented to improve performance. Vendor recommendations will be considered in this evaluation. In the interim, the inspection frequency of the valves is being changed to require an inspection at once per outage.

The cause for the second HPCI start was personnel error. The reset sequence error associated with the second start of HPCI was discussed with the involved operator. This event will be reviewed during operator classroom training and the proper sequence to reset the trip logic emphasized in simulator training.

The RWCU heat exchanger has a history of gasket leaks between the shell head and channel head. Leakage from this type of heat exchanger in this application has been an industry problem. A permanently designed external clamp had been previously installed as a supplemental leak seal to the gasket.

The RWCU heat exchanger leak was reduced by injecting leak sealant into the valve flange. 1_/

1_/Actions described in Section V are being tracked by TVA's Corrective Action Program and are not considered regulatory commitments.

VI. ADDITIONAL INFORMATION

A. Failed Components:

The feedwater discharge check valve is an 18-inch swing check

valve Model 828A with air assisted actuator manufactured by

Ametek, Schutte and Koerting Division.

The RWCU heat exchanger is a Perfex Model CEU fitted with an

engineered clamp assembly.

B. Previous LERS on Similar Events:

No other LERs were identified which were caused by failure of a

reactor feedpump discharge check valve.

VII. COMMITMENTS

None.

Energy Industry Identification System (EIIS) system and component codes

are identified in the text with brackets (e.g., [XX]).

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TVA

Tennessee Valley Authority, Post Office Box 2000, Decatur,

Alabama 35609-2000

R. D. (Rick) Machon

Vice President, Browns Ferry Nuclear Plant

May 21, 1996

U.S. Nuclear Regulatory Commission 10 CFR 50.73

ATTN: Document Control Desk

Washington, D.C. 20555

Dear Sir:

BROWNS FERRY NUCLEAR PLANT (BFN) - UNITS 1, 2, AND 3 - DOCKET NOS. 50-259, 260, and 296 - FACILITY OPERATING LICENSE DPR-33, 52, AND 68 - LICENSEE EVENT REPORT 50-296/96002

The enclosed report provides details concerning a reactor scram. The scram occurred following the loss of reactor feedpump 3C that was caused by a valve alignment error.

The discharge check valve on the affected reactor feedpump was damaged during the pump trip transient and failed to fully seat. The remaining two operable reactor feedpumps were unable to provide sufficient feed flow to maintain vessel water level due to back flow through reactor feedpump 3C, and the unit subsequently scrammed on low reactor water level. TVA is performing a failure evaluation of the reactor feedpump discharge valve to determine what modifications are needed to improve the performance of the check valves.

This report is submitted in accordance with 10 CFR 50.73(a)(2)(iv) as a condition that resulted in automatic actuation of any engineered safety feature including the reactor protection system.

Sincerely,

R. D. Machon

Enclosure

cc: See page 2

Enclosure

cc (Enclosure):

Mr. Mark S. Lesser, Branch Chief

U.S. Nuclear Regulatory Commission

Region II

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